Biodynamic agriculture

Part of a series on
Anthroposophy
General
Anthroposophy · Rudolf Steiner Anthroposophical Society · Goetheanum
Anthroposophically inspired work
Waldorf education Biodynamic agriculture Anthroposophical medicine Camphill Movement · Eurythmy
Philosophy
Philosophy of Freedom · Social threefolding

Biodynamic agriculture is a method of organic farming that emphasizes the holistic development and interrelationships of the soil, plants and animals as a self-sustaining system.[1][2][] One of the first modern ecological farming systems,[][3][4][5] it emphasizes a sustainable approach to agriculture.[][6]

Biodynamics has much in common with other organic approaches – it emphasizes the use of manures and composts and excludes the use of artificial chemicals on soil and plants. Methods unique to the biodynamic approach include its treatment of animals, crops, and soil as a single ecosystem; an emphasis from its beginnings on local production and distribution systems; its use of traditional and development of new local breeds and varieties; and the use of a sowing and planting calendar. Biodynamic agriculture uses various herbal and mineral additives for compost additives and field sprays; these are sometimes prepared by mystical (and controversial) methods, such as burying ground quartz stuffed into the horn of a cow, which are said to harvest "cosmic forces in the soil", and appear more akin to sympathetic magic than modern agronomy.

As of 2011 biodynamic techniques were used on 142,482 hectares in 47 countries; Germany accounts for 45.1% of the global total.[7] Biodynamic methods of cultivating wine grapes have been taken up broadly, including by notable vineyards[8] There are independent certification agencies for biodynamic products; most of these agencies are members of the international biodynamics standards group Demeter International.

Biodynamic agriculture has been characterized as pseudoscience,[9][10][11][12] a stance that Leiber, Fuchs and Spieß consider a misunderstanding.[13] Its founder, Rudolf Steiner, and its developers characterize it as "spiritual science", and they advocate taking a holistic view rather than a reductionist view.[][14]

History

The development of biodynamic agriculture began in 1924 with a series of eight lectures on agriculture given by philosopher Rudolf Steiner at Schloss Koberwitz in Silesia, Germany, (now Kobierzyce in Poland southwest of Wrocław).[15] The lectures, the first known to have been given on organic agriculture,[] were held in response to a request by farmers who noticed degraded soil conditions and a deterioration in the health and quality of crops and livestock resulting from the use of chemical fertilizers.[16] The one hundred and eleven attendees, less than half of whom were farmers, came from six countries, primarily Germany and Poland.[] The lectures were published in November 1924; the first English translation appeared in 1928 as *The Agriculture Course*.[17]

Steiner emphasized that the methods he proposed should be tested experimentally. An "Association for Research in Anthroposophical Agriculture" (Versuchsring anthroposophischer Landwirte), directed by the German agronomist

Erhard Bartsch, was formed to test the effects of biodynamic methods on the life and health of soil, plants and animals; the group published a monthly journal *Demeter*.[14] Bartsch was also instrumental in developing a sales organisation for biodynamic products, Demeter, which still exists today. The Research Association was renamed The Imperial Association for Biodynamic Agriculture (Reichsverband für biologisch-dynamische Wirtschaftsweise) in 1933. It was dissolved by the National Socialist regime in 1941. In 1931 the association had 250 members in Germany, 109 in Switzerland, 104 in other European countries and 24 outside Europe. The oldest biodynamic farms are the Wurzerhof in Austria and Marienhöhe in Germany.[18]

In 1938, Ehrenfried Pfeiffer's groundbreaking text *Bio-Dynamic Farming and Gardening* was published in five languages – English, Dutch, Italian, French, and German; this became the standard work in the field for several decades.[14] In July 1939, at the invitation of Walter James, 4th Baron Northbourne, Pfeiffer travelled to the UK and presented the 'Betteshanger Summer School and Conference on Biodynamic Farming' at Northbourne's farm in Kent.[19] The conference has been described as the 'missing link' between biodynamic agriculture and organic farming because, in the year after Betteshanger, Northbourne published his manifesto of organic farming, *Look to the Land*, in which he coined the term 'organic farming' and praised the methods of Rudolf Steiner.[19] In the 1950s, Hans Mueller was encouraged by Steiner's work to create the organic-biological farming method in Switzerland; this later developed to become the largest certifier of organic products in Europe, *Bioland*.[1]:5

Today biodynamics is practiced in more than 50 countries worldwide and in a very great variety of circumstances, ranging from temperate arable farming, viticulture in France, cotton production in Egypt, to silkworm breeding in China.[13]:141 Germany, Italy and India are reported to be the leading countries in biodynamic agriculture based on biodynamic hectares.[20] Demeter International is the primary certification agency for farms and gardens using the methods.

Geographic developments

- In Australia the first biodynamic preparations were made by Ernesto Genoni in Melbourne in 1927.[21] Bob Williams presented the first public lecture in Australia on biodynamic agriculture on 26 June 1938 at the home of the architects Walter Burley Griffin and Marion Mahony Griffin at Castlecrag, Sydney.[22] Since the 1950s research work has continued at the Biodynamic Research Institute (BDRI)[23] in Powelltown, near Melbourne Australia under the direction of Alex Podolinsky.[24] In 1989 Biodynamic Agriculture Australia was established, as a not for profit association.
- In 1928 the *Anthroposophical Agricultural Foundation* was founded in England;[14] this is now called the *Biodynamic Agriculture Association*. In 1939, Britain's first biodynamic agriculture conference, the Betteshanger Summer School and Conference on Biodynamic Agriculture, was held at Lord Northbourne's farm in Kent; Ehrenfried Pfeiffer was the lead presenter.[25]
- In the United States, the Biodynamic Farming & Gardening Association was founded in 1938 as a New York state corporation.
- In France the International Federation of Organic Agriculture Movements (IFOAM) was formed in 1972 with five founding members, one of which was the Swedish Biodynamic Association.[26]
- The University of Kassel had a Department of Biodynamic Agriculture from 2006 to March 2011.[27]

Biodynamic method of farming

In common with other forms of organic agriculture, biodynamic agriculture uses management practices that "restore, maintain and enhance ecological harmony."[4] Central features include crop diversification, the avoidance of chemical soil treatments and off-farm inputs generally, decentralized production and distribution, and the consideration of celestial and terrestrial influences on biological organisms.[4][28]

The individual design of the holding "by the farmer, as determined by site conditions, is one of the basic tenets of biodynamic agriculture. This principle emphasizes that humans have a responsibility for the development of their ecological and social environment which goes beyond economic aims and the principles of descriptive ecology."[13]:141-142 Crops, livestock, and farmer, and "the entire socioeconomic environment" form a unique interaction, which biodynamic farming tries to "actively shape ...through a variety of management practices. The prime objective is always to encourage healthy conditions for life": soil fertility, plant and animal health, and product quality.[13]:141-142 "The farmer seeks to enhance and support the forces of nature that lead to healthy crops, and rejects farm management practices that damage the environment, soil plant, animal or human health....the farm is conceived of as an organism, a self-contained entity with its own individuality,"[29]:148 holistically conceived and self-sustaining.[4]

Biodynamic agriculture differs from many forms of organic agriculture in its spiritual, mystical, and astrological orientation. It shares a spiritual focus, as well as its view toward improving humanity, with the "nature farming" movement in Japan.[1]:5 Important features include the use of livestock manures to sustain plant growth (recycling of nutrients), maintenance and improvement of soil quality, and the health and well being of crops and animals.[16] Cover crops, green manures and crop rotations are used extensively and the farms foster the bio-diversity of plant, insect, bird, and other animal life. They also work to enhance the biological cycles and the biological activity of the soil.[4]

Biodynamic farms often have a cultural component and encourage local community, both through developing local sales and through on-farm community building activities. Some biodynamic farms use the Community Supported Agriculture model, which has connections with social threefolding.

Compared to non-organic agriculture, BD farming practices have been found to be more resilient to environmental challenges, to foster a diverse biosphere, and to be more energy efficient, factors Eric Lichtfouse describes being of increasing importance in the face of climate change, energy scarcity and population growth.[30]

Biodynamic preparations

Steiner prescribed nine different preparations to aid fertilization, and described how these were to be prepared. Steiner believed that these preparations mediated terrestrial and cosmic forces into the soil.[] The prepared substances are numbered 500 through 508, where the first two are used for preparing fields whereas the latter seven are used for making compost. A long term trial (DOK experiment) evaluating the biodynamic farming system in comparison with organic and conventional farming systems, found that preparations have influence on soil structure and micro-organisms enhancing soil fertility and increasing biodiversity.[] Regarding compost development beyond accelerating the initial phase of composting, some positive effects have been noted:[31]

- The field sprays contain substances that stimulate plant growth include cytokinins.
- Some improvement in nutrient content of compost.

Field preparations

Field preparations, for stimulating humus formation:

- **500**: (horn-manure) a humus mixture prepared by filling the horn of a cow with cow manure and burying it in the ground (40–60 cm below the surface) in the autumn. It is left to decompose during the winter and recovered for use the following spring.
- **501**: Crushed powdered quartz prepared by stuffing it into a horn of a cow and buried into the ground in spring and taken out in autumn. It can be mixed with 500 but usually prepared on its own (mixture of 1 tablespoon of quartz powder to 250 liters of water) The mixture is sprayed under very low pressure over the crop during the wet season, in an attempt to prevent fungal diseases. It should be sprayed on an overcast day or early in the morning to prevent burning of the leaves.

Both 500 and 501 are used on fields by stirring about one teaspoon of the contents of a horn in 40–60 liters of water for an hour, creating vortexes in alternate directions.

Compost preparations

Compost preparations, used for preparing compost, employ herbs which are frequently used in medicinal remedies:

- **502**: Yarrow blossoms (*Achillea millefolium*) are stuffed into urinary bladders from Red Deer (*Cervus elaphus*), placed in the sun during summer, buried in earth during winter and retrieved in the spring.
- **503**: Chamomile blossoms (*Matricaria recutita*) are stuffed into small intestines from cattle buried in humus-rich earth in the autumn and retrieved in the spring.
- **504**: Stinging nettle (*Urtica dioica*) plants in full bloom are stuffed together underground surrounded on all sides by peat for a year.
- **505**: Oak bark (*Quercus robur*) is chopped in small pieces, placed inside the skull of a domesticated animal, surrounded by peat and buried in earth in a place where lots of rain water runs past.
- **506**: Dandelion flowers (*Taraxacum officinale*) are stuffed into the mesentery of a cow and buried in earth during winter and retrieved in the spring.
- **507**: Valerian flowers (*Valeriana officinalis*) are extracted into water.
- **508**: Horsetail (*Equisetum*)

One to three grams (a teaspoon) of each preparation is added to a dung heap by digging 50 cm deep holes with a distance of 2 meters from each other, except for the 507 preparation, which is stirred into 5 liters of water and sprayed over the entire compost surface. All preparations are thus used in homeopathic quantities. Each compost preparation is designed to guide a particular decomposition process in the composting mass.

One study found that the oak bark preparation improved disease resistance in zucchini.[31]

Planting calendar

The approach considers that there are lunar and astrological influences on soil and plant development, for example, choosing to plant, cultivate or harvest various crops based on both the phase of the moon and the zodiacal constellation the moon is passing through.[32][33] This aspect of biodynamics has been termed "astrological" in nature.[34]

Seed production

Biodynamic agriculture has focused on the open pollination of seeds (with farmers thereby generally growing their own seed) and the development of locally adapted varieties. The seed stock is not controlled by large, multinational seed companies.[35]

Biodynamic certification

The biodynamic certification Demeter, created in 1924, was the first certification and labelling system for organic production.[1]:5 To receive certification as a biodynamic farm, the farm must meet the following standards: agronomic guidelines, greenhouse management, structural components, livestock guidelines, and post harvest handling and processing procedures.[36]

The term *Biodynamic* is a trademark held by the Demeter association of biodynamic farmers for the purpose of maintaining production standards used both in farming and processing foodstuffs.(This is not a trademark held privately in New Zealand) The trademark is intended to protect both the consumer and the producers of biodynamic produce. Demeter International is an organization of member countries; each country has its own Demeter organization which is required to meet international production standards (but can also exceed them). The original Demeter organization was founded in 1928; the U.S. Demeter Association was formed in the 1980s and certified its first farm in 1982. In France, Biodivin certifies biodynamic wine.[37] In Egypt, SEKEM has created the Egyptian Biodynamic Association (EBDA), an association that provides training for farmers to become certified.[38]

Studies of efficacy

Studies have compared biodynamic farming methods to both other organic methods and to conventional methods. Most studies have found that biodynamic farms have soil quality significantly better than conventionally farmed soils but comparable to the soil quality achieved by other organic methods; the decisive factor is likely to be the use of compost.[39]

Reviews

A 2009/2011 review found that biodynamically cultivated fields:[][]:23

- achieve lower absolute yields but better efficiency of production (relative to energy input) Wikipedia:Vagueness
- had greater earthworm populations and biomass than conventional farms; both factors were similar to the result in organically cultivated fields.
- maintained or slightly improved the organic carbon levels, while both organic and conventional farming techniques resulted in a loss of organic carbon. Wikipedia:Verifiability
- had higher microbial biomass carbon and dehydrogenase activity than those of either organically or conventionally farmed fields. Wikipedia:Verifiability

Individual studies

Individual studies have found:

- A long-term study conducted at a commercial vineyard in California compared vineyard blocks treated with biodynamic preparations alongside those tended with general organic farming methods, to examine effects upon soil and crop quality. "No differences were found in soil quality" during the first six years of the study, and analyses of other indicators including the yield per vine, clusters per vine, cluster and berry weight also showed there were no differences. The study did find a statistically significant (p-value < 0.05) difference in the yield-to-pruning weight ratio, indicating an "ideal vine balance for producing high-quality wine grapes" for the biodynamically treated crop, but noted the control vines had been "slightly overcropped". In one particular year of the study the biodynamically treated wine grapes had significantly higher Brix and notably higher total phenols and anthocyanins. In conclusion, the study found that biodynamic preparations "may affect" the vine canopy and chemistry, but showed no effects on the soil and tissue nutrient parameters measured in the study.[40]
- Decomposition was significantly faster in plots which received farmyard manure (FYM) treated with biodynamic preparations than in plots which received no FYM, FYM without preparations or FYM with an alternative preparation. "The application of completely prepared FYM led to significantly higher biomass and abundance of

endogeic or anecic earthworms than in plots where non-prepared FYM was applied."[41]

- A 21-year study by Mäder *et al* for the FiBL Institute in Switzerland compared the agronomic and ecological performance of biodynamic, organic and two conventional systems. The study found that nutrient input in the biodynamic and organic systems was 34 to 51% lower than in the conventional systems but crop yield was only 20% lower on average, indicating more efficient production. The total energy (for fuel, production of mineral fertilizer and pesticides, etc.) to produce a dry-matter unit of crop was 20 to 56% lower for the biodynamic and organic systems, and pesticide input was reduced by 97% (by 100% for the biodynamic system). In regard to soil aggregate stability, soil pH, humus formation, soil calcium, microbial biomass, and faunal biomass (earthworms and arthropods), the biodynamic system was superior even to the organic system, which in turn had superior results over the conventional systems. With the significant increase in microbial diversity in the biodynamic and organic systems, there was a significant associated decrease in metabolic quotient, indicating a greater ability to use organic material for plant growth.[42][43]
  - The methodology of this study was criticized by two wine writers—philosophy professor Douglass Smith and criminology professor Jesús Barquín—for failing to separate mystical elements in biodynamics from standard organic techniques and for comparing biodynamic farming with both organic and conventional, rather than solely with organic methods. Supplemental materials, found online but not in the published paper, described significant differences between the biodynamic and the organic methodology; for instance, unspecified chemicals were added to the organic farm's compost, possibly leading to its slightly poorer performance.[44][45]
  - Leading[46] UK biologist Anthony "Tony" Trewavas criticized the study for poorly representing conventional integrated farm management (IFM) methods, with Mäder *et al*'s reported conventional yields some 40% lower than what he sees routinely.[] Trewavas paraphrased Holger Kirchmann's conclusions in saying that Steiner's farming method "with its belief in cosmic forces has no place in any scientific discussion and is considered occult in character."[]
- In 1999, Joachim Raupp of the Institute for Biodynamic Research reported that in a long-term trial across four fields of rotating crops, the use of biodynamic preparations with organic fertilizer was found to increase soil organic matter content significantly more than the same quantity of organic fertilizer without the preparations; both forms of organic applications increased soil organic matter more than mineral fertilizer. However, Raupp noticed that crop yield did not follow the same pattern: the yield of spring wheat was the same no matter which fertilizer was used, and mineral fertilizers produced 33% more winter rye and 10% more potatoes than organic fertilizers with or without biodynamic additives.[47]
- A further study investigated whether biodynamic preparations had any effect on the yield and growth of lentil and wheat crops, weed populations and soil fertility in the short term. The study found that "[i]n general, soils and crops treated with biodynamic preparations showed few differences from those not treated". Plots tended with biodynamically treated compost produced results for yield, crop quality and soil fertility that were the same to those tended with non-biodynamic composts and NPK fertilizers. Some alteration was observed in the nitrogenous chemistry of the soil and grain where biodynamic field sprays were applied, but the study did not ascribe or discern any biological significance to the difference. Among the variables considered by the study, some measured outcomes correlated with biodynamic field spray usage, including a higher per-unit biomass yield ratio for lentils and a lowering of carbon and crude protein contents in wheat grains. The study's conclusion remarked that "any additional short-term benefits from biodynamic preparations remain questionable."[48]
- Minor effects for the field sprays on the carbon content and soil microbial fatty acid profile, but no effects for the compost preparations[49]
- A 1993 study compared soil quality and financial performance of biodynamic and conventional farms in New Zealand. The study reported that, "The Biodynamic farms proved in most enterprises to have soils of higher biological and physical quality: significantly greater in organic matter, content and microbial activity, more earthworms, better soil structure, lower bulk density, easier penetrability, and thicker topsoil."[50] The biodynamic

farms were just as financially viable on a per hectare basis.[50] The study compared biodynamic farms with adjacent conventional farms, but didn't attempt to compare farms of similar size, or with similar crops.

Reception

Critiques of methodology

Biodynamic agriculture has been criticized as pseudoscience by some critics. In a 2002 newspaper editorial, Peter Treue characterized biodynamics as pseudoscience and argued that similar or equal results can be obtained using standard organic farming principles. He wrote that the biodynamic preparations more resemble alchemy or magic akin to geomancy.[51]

In a 1994 analysis, Holger Kirchmann, a soil researcher with the Swedish University of Agricultural Sciences, concluded that Steiner's instructions were occult and dogmatic, and cannot contribute to the development of alternative or sustainable agriculture and that many of Steiner's statements are not provable because scientifically clear hypotheses cannot be made from his descriptions (for example, it is hard to prove that one has harnessed "cosmic forces" in the foods). Kirchmann asserted that when methods of biodynamic agriculture were tested scientifically, the results were unconvincing.[] Further, in a 2004 overview of biodynamic agriculture, Linda Chalker-Scott, a researcher at Washington State University, characterized biodynamics as pseudoscience, writing that Steiner did not use scientific methods to formulate his theory of biodynamics, and that the later addition of valid organic farming techniques has "muddled the discussion" of Steiner's original idea. Based on the scant scientific testing of biodynamics, Chalker-Scott concluded "no evidence exists" that homeopathic preparations improve the soil.[]

In Michael Shermer's two-volume work, *The Skeptic Encyclopedia of Pseudoscience*, biodynamic agriculture is described as relying on astrological conditions, cosmic influences and magical rituals.[52] Skeptic Brian Dunning writes "the best way to think of [biodynamic agriculture] would be as a magic spell cast over an entire farm. Biodynamics sees an entire farm as a single organism, with something that they call a life force."[53]

Fuchs, Leiber, and Spieß suggest that critiques of biodynamic agriculture that deny it scientific credibility are "not in keeping with the facts...as they take no notice of large areas of biodynamic management and research." Biodynamic farmers are "charged with developing a continuous dialogue between biodynamic science and the natural sciences *sensu stricto*," despite important differences in paradigms, world views, and value systems.[13]:147

Biodynamic wine

As of 2006, more than 200 wineries worldwide were certified as biodynamic; numerous other wineries employ biodynamic methods to a greater or lesser extent.[54] Family-owned businesses that emphasise "organic, sustainable and biodynamic" want "to pass on healthier farms and businesses to the next generation".[55]

Notes

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External links

- "The methods behind biodynamic bounty" (http://www.telegraph.co.uk/earth/earthcomment/3346939/The-methods-behind-biodynamic-bounty.html), *Telegraph*, July 11, 2008
- Biodynamics Section at the Rudolf Steiner Archive, An Online Library (http://www.rsarchive.org/Biodynamics/)
- "Biodynamic agriculture shows steady global growth" (http://oneco.biofach.de/en/news/biodynamic-agriculture-shows-steady-global-growth--focus--d93f8e9e-ff78-4609-b1b3-5847a5a679cb/?focus=d93f8e9e-ff78-4609-b1b3-5847a5a679cb&rate=4) 2013

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